

THE IMPACT OF AN ONLINE MATHEMATICS EDUCATION PROJECT (MATACTIVA) ON HIGHER EDUCATION STUDENTS

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Abstract

The Online Mathematics Education Project (MatActiva) is an exciting new initiative which aims to support and enhance mathematics education. The project is led by the Institute of Accounting and Administration of Porto (ISCAP), part of the Polytechnic Institute of Porto (IPP). It provides innovative resources and carefully constructed materials around themes such as Elementary Mathematics, Calculus, Algebra, Statistics and Financial Mathematics to help support and inspire students and teachers of mathematics. The goal is to increase mathematical understanding, confidence and enjoyment, enrich the mathematical experience of each person, and promote creative and imaginative approaches to mathematics. Furthermore the project can be used to deliver engaging and effective mathematics instruction through the flipped classroom model. This paper also presents the findings of a large survey, whose propose was to study the student's reaction to the project.

Keywords: Moodle, Online Learning, Open Education, Information and Communication Technologies (ICT) in Education, Flipped Classroom.

1 INTRODUCTION

Higher Education Institutions (HEI) have been living significant changes, highlighting the growth of Distance Education and the use of technology in teaching and learning. The computer is a significant part of the learner's daily life. It is, by now, inevitable that methods of teaching and learning should include e-learning components that are based on the computer environment which requires a new pedagogy. This new pedagogy, in the case of math science teaching and learning, according to [1] should employ: High-order thinking and learning skills; a constructivist approach to science teaching and learning; information, communication, and scientific literacy skills using digital means and advanced technologies.

Online Learning is based on concepts such as independent learning, active learning, self-directed learning, problem based education, simulations, and work-based learning [2]. Most of these models are based on constructivism in which, according to [3], learners become responsible for regulating their own learning process.

Moodle permits the incorporation of an extensive range of resources, from chats and forums to online booklets, a variety of questions, collections of problems and exercises, lecture notes; including any kind of text-based or Html formatted documents, multimedia resources such as graphics, video or audio, PowerPoint, or Flash-based applications and Java applets [4]. Moodle gives educators the best tools to manage and stimulate learning and lets instructors to organize, manage and deliver course materials.

In the past few years, HEI have been faced with a decreasing mathematical knowledge among first year students [5]. On the other hand, professors that teach the first year students say that the most important factor of success in particularly those in which Mathematics is a necessary pre requisite for their courses is the mathematical competence of the students. Therefore, the improvement of these skills provides an important task for today's HEI. Thinking in overcoming these problems we developed a project called *MatActiva* based on the Moodle platform.

2 MOODLE IN THE INSTITUTE OF ACCOUNTING AND ADMINISTRATION OF PORTO (ISCAP)

ISCAP began its online support project in 2003 with WebCT, but soon changed its approach with the adoption of the open source platform Moodle (Modular Object-Oriented Dynamic Learning Environment). The main goals of the project were to provide the implementation of computer-assisted education at ISCAP in a blended learning model and to assist teachers and students in their

adjustment to educational technologies, by developing training opportunities and resources, offering technical facilities and sharing good practices.

Integrating the open source LMS Moodle has allowed students online access to the subjects taught in class as well as new learning activities. Moodle offers a set of activities adaptable to the contents of the most diversified subjects. It has several activities that can be used differently as educational instruments. It is possible to insert texts and the necessary documentation for the subjects, to suggest assignments, promote discussion forums and to create term glossaries in a cooperative form. The assessment and self-evaluation of knowledge is done through the pages of lessons and questionnaires [6].

Since the introduction of the Moodle at ISCAP the number of users has been grown year after year.

The evolution of the number of users (teachers) of the platform can be seen in Fig. 1.

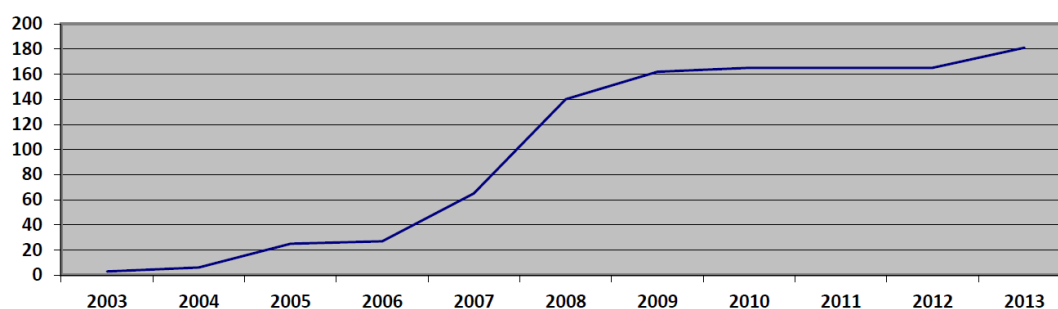


Fig. 1 – Evolution in the adoption of Moodle at ISCAP [7]

Over the last 10 years, the initial project has developed and in turn, has brought about significant shifts in the school's educational culture and pedagogical practices, specifically regarding the teacher's enthusiasm or availability to integrate technology in the teaching-learning process.

The prospect of the use of the LMS in authentic educational environments is excellent. Real proof is Moodle which is by far the most popular open source LMS and maybe the most popular LMS in actuality, with over 6 million online or blended learning courses in 200 countries that 58 million students attend with the support of more than 1 million teachers [8].

MatActiva was developed to supplement our theoretical and practical classes. In the last versions of *Moodle*, it is possible use the TeX language to create math questions. Using this tool and taking advantage of already obtained results with the previous experiences we have created a set of interactive materials, giving to the students opportunities to complement their study in Mathematics [9].

3 AIMS AND STRUTURE OF MATACTIVA PROJECT

The project was started in 2007, targeting first year students (home students, distance students, ERASMUS students, Lifelong Learners) who have weak Math preparation, poor consolidated basis on the subject and different backgrounds, wanting to improve their performance and success in the math courses through the online Moodle platform.

The general objective of this project is to increase the Math literacy of the students and their rate of success in Mathematics, taking into account that this subject is an essential component of all educational systems. The project will serve a big number of students by helping those developing Math skills and consequently increasing their opportunities to job market insertion after graduation.

The main objective of this project was to innovate the teaching and learning process exploring technologies as a pedagogical resource and to induce bigger motivation to the students, improve the rate of success and make available to students a set of materials adapted to their needs. This concern is justified due to the fact that students have a weak preparation without consolidated basis.

One of the great objectives is to motivate students, encourage them to overcome their difficulties through a self-study giving them more confidence.

The pedagogical innovation and flexibility temporal supporting the individual and collaborative study of students, has been of great importance especially for the working students who can not always attend

classes and timely access to the support materials. The aim is not to replace the classroom presence but a complement to these.

The specific objectives underlying the elaboration of this project were to create a secure repository for documents, providing support material, promote self-learning, increase the self-confidence of students, and increase the communication among fellow students and among students and teachers.

We have been concerned in creating a project of simple access, intuitive and with a set of useful functionalities according to the subjects taught in mathematics department, such as Algebra, Calculus, Statistics, Financial Mathematics, etc...

In Fig. 2 we can observe the initial menu of MatActiva with 8 topics.



Fig.2 Screenshot of the initial menu of MatActiva <http://paol.iscap.ipp.pt/matactiva/> (21/01/2015).

The 8 topics that we can find in the initial menu are:

- About us – Information about the project, who we are and what we are doing.
- Mathematics Zero – An area that serves as support for the students who have difficulties and gaps in basic mathematics. They can find here video lectures followed by a set of proposed exercises related with the issue presented in the video. The students have access to a support documents to the subjects/classes of this course. They can also find and solve online diagnostic tests and determining if they have the prerequisites skills necessary for the different subjects.
- Learning – In this topic students can find interactive eBooks which were designed and created with the study tools they need, such as: guide lessons about topics related with the contents taught in several subjects of mathematics, great math formulas resources and math tables. They can find as well links to pages about mathematical contents that could be useful for their study.
- Tests – At this point the students can find and solve online diagnostic tests, evaluation tests with multiple choice or true / false questions. We have created a large bank of questions that originated a series of self-evaluation tests, which the student can solve and submit, taking conscience of their level of knowledge.
- Doubts – Here the students can put their doubts online and there is a teacher that gives online answers. Some authors such as Cole [10] are of the opinion that more students are willing to participate in an asynchronous forum than are willing to speak up in class because forums are asynchronous and students can take their time composing a reply. Forum allows all participants to communicate with each other, and may question professors and other participants about all kind of doubts they have in course context.
- MathChallenge – Is a competition open to all ISCAP community, with a set of 6-7 challenges / problems throughout the school year in order to stimulate student interest for mathematics. Learning mathematics should also be done through activities research and discovery. The challenges reinforce the motivation, thinking and communication. Every year in the ISCAP Day ceremony, awards are delivered to the three winners of MatDesafio of the previous school year.
- ERASMUS – Since the ISCAP receive ERASMUS students, who choose subjects from Mathematics area, in this topic are multiple choice tests in English;

- ETC – We can find here some humour, curiosities, contests and a Games Blogger (Fig. 3) including mathematical contents to test the math skills, so that students can relax a little and enjoy mathematics and see how mathematics are amazing.



Fig.3 Screenshot of the game blogger of MatActiva <http://matactiva2007.blogspot.pt/> (21/01/2015).

All the topics have a different structure, for instance in Mathematics Zero we have two distinct sections (Fig. 4) – Video Lectures – addressing the fundamental concepts, go together with some examples and solved problems, and the section – Proposed Exercises – a group of 6 randomly selected questions, from a question bank specifically created for this course, to be solved for consolidation of learning providing furthermore sequential moments of self-assessment.



Fig.4 Screenshot of the Mathematics Zero Topic <http://paol.iscap.ipp.pt/matactiva/> (21/01/2015).

Regarding Video-lectures, some authors [11] are of the opinion that video styles have different effects on learning performance and students' enrolment. We have chosen the very popular Voice Over Presentation style, whose main component is usually a PowerPoint presentation, complemented with a voice over explaining the slides. The videos duration are between 5 and 10 minutes and were created with Camtasia Studio software for a dynamical editing.

The topic of Tests presents more than 1 100 questions in a Pool of Questions divided into categories according to the four subjects – Algebra, Calculus, Statistics and Financial Mathematics. In each quiz, participants can take multiple attempts at each of them. This can help to make over the quiz taking process into an educational activity instead of a simple assessment. Since all the quizzes are random, the student will get a new version in each attempt, which will be useful for practice purposes. Feedback is provided for each question, allowing students to see the proposed solution, step by step, as showed in Fig. 5. The Pool of Questions, from which the quizzes are randomized, is categorized separately by learning items (modules) and each section has three subsections, namely: Easy, Medium, and Difficult.

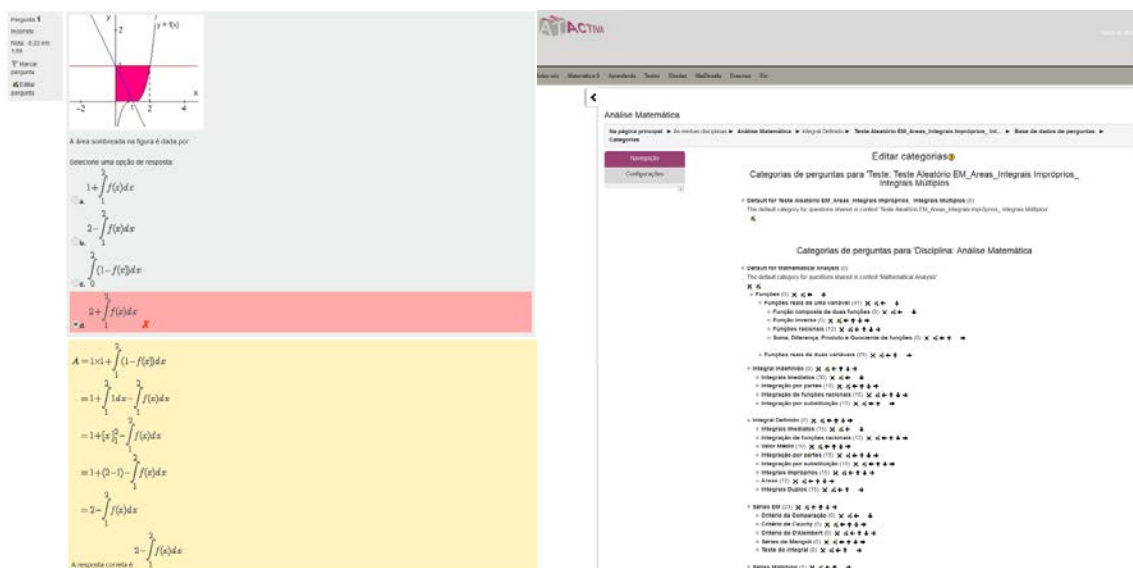


Fig. 5 Screenshots of Feedback / Categories <http://paol.iscap.ipp.pt/matactiva/> (21/01/2015).

4 SURVEY RESULTS

At the end of the winter semester of the academic year 2013/2014, a survey was conducted, which main objective was to know the opinion of the students about the MatActiva Project. 527 students participated in a Paper-and-pencil questionnaire, where the items were presented on paper. More than half of respondents, 62% know the MatActiva Project (Fig. 6).

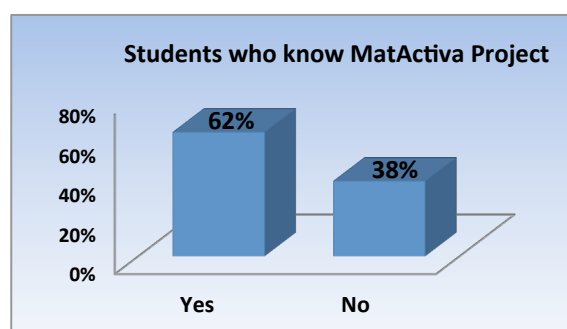


Fig. 6 Number of students who know MatActiva Project.

From those who know the Project, 55% of the students used MatActiva in their study (Fig.7)

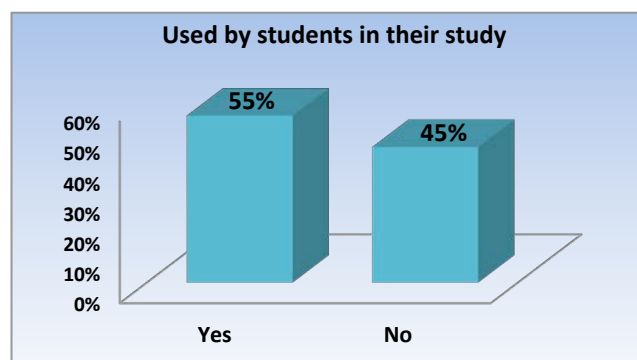


Fig. 7 Number of students who have used MatActiva Project in their study.

The results of the survey were a pleasant surprise where a higher-than-expected percentage of students, 85%, agreed that MatActiva contributes to its success in Mathematics subject (Fig.8).

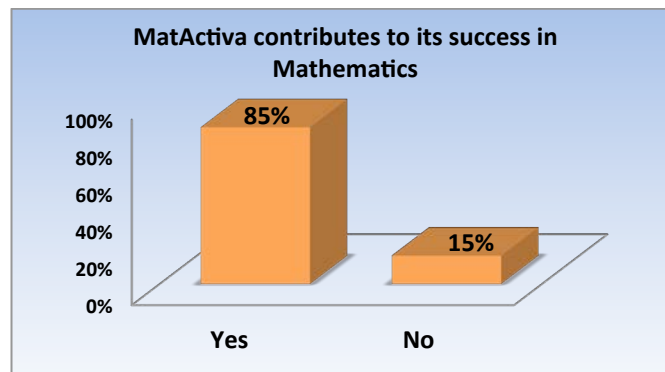


Fig. 8 Number of students who agreed that MatActiva contributes to its success in Math subject.

Respondents in the study also were asked to identify the topics of MatActiva that were most effective in supporting their learning. Those identified were, the Tests (by 83%), Mathematics Zero (by 72%), Learning (by 65%) and MathChallenge (by 52%). The ERASMUS and Doubts Forum were considered the least effective element of MatActiva, with only 23% agreeing they were effective.

5 CONCLUSION AND FUTURE WORK

This article has presented a project led by the Institute of Accounting and Administration of Porto (ISCAP), part of the Polytechnic Institute of Porto (IPP), that provide innovative resources and constructed materials around topics such as Elementary Mathematics, Calculus, Algebra, Statistics and Financial Mathematics to help support and motivate students and teachers of mathematics.

The results of our survey are positive. The statistics in this paper don't really prove anything yet, but at least they illustrate the desire of students and instructors to push the boundaries of what is considered traditional in order to realize greater educational benefits. We plan in future to use them to further enhance the concept to improve the mathematical competences of the students.

Nowadays, learning analytics is a growing area of research for technology enhanced learning that differentiates itself through a focus on providing value to the teaching and learning process [12]. Several learning analytics are being studied around social Learning Analytics, feedback and engagement, feedback and assessment. Therefore, it is important to see how learning analytics can be exploited to provide another assessment system through formative feedback and engagement. As future work, we would like to explore the potential of Moodle analytics to provide feedback to both the students and the instructors about student activities in relation to the design, structure and content of a module, and also to provide feedback to students on how they use these resources.

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